GOALIE WITHOUT A MASK? THE EFFECT OF THE ANTI-PERSONNEL LANDMINE BAN ON U. S. ARMY COUNTERMOBILITY OPERATIONS

A MONOGRAPH
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ABSTRACT

GOALIE WITHOUT A MASK?: THE EFFECT OF THE ANTI-PERSONNEL LAND MINE BAN ON US ARMY COUNTERMOBILITY OPERATIONS by MAJ Daniel P. Mahoney III, USA, 51 pages.

This monograph examines whether the United States' unilateral ban on conventional anti-personnel mines will significantly impair the effectiveness of US Army countermobility operation. Land mines and mine warfare play critical roles in US countermobility doctrine, and the loss of one entire category of mines could constrain the Army's ability to successfully perform countermobility missions. The prospect of such failure is alarming since successful mine warfare has often been the difference between life and death for hard pressed defenders. This monograph attempts to anticipate both the nature and severity of such consequences.

The monograph begins by exploring the origins and nature of the anti-personnel mine ban. It does this by tracing the history of mines and mine warfare, and the global problems that this history has created. Next, the paper covers the current US inventory of anti-personnel mines to determine which mines (and capabilities) the ban eliminates. The monograph then examines the tasks that land mines serve under countermobility doctrine. This section is particularly important since it introduces the concepts that the paper later uses in the analysis. The monograph completes its "fact gathering" focus with a treatment of the countermine measures available to modern armies. Once the background knowledge set is complete, the monograph turns to analyzing the ban's effects.

The monograph's analysis portion begins with a brief discussion of the Second Battle of El Alamein. The monograph uses this action as its "historical laboratory" because land mines played a central role in the battle, but very few of the mines (only three percent) were of the anti-personnel variety. For this (and other) reasons therefore, Alamein approximates battle under the ban. The monograph then uses examples from history to explore mine warfare's ability to carry out each of its doctrinal countermobility tasks under the ban's constraints.

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I. Introduction

One cold January night in 1972, Gerry "Cheesy" Cheevers was defending his assigned position when he came under attack by superior forces. Exposed, alone and outnumbered, the Boston Bruins' goalie watched as the Detroit Redwings' center intercepted an errant pass, and made a fast break with another Redwings player toward the Boston goal. The rapidly closing center faked a pass to his team mate and then fired a slapshot toward the goal. Gerry dove to his left to intercept the streaking puck and managed to get his head into the flight path. The puck ricocheted painfully off his mask, but missed the goal. After the game, Gerry sat in the locker room with his head still ringing from the impact. As he studied the new black smudge on his mask he said "Well, that was worth about eight." He then handed the mask to the trainer who added a replica of eight stitches to the hundreds of other stitches already depicted on the mask.[1] While Cheevers could have accomplished his mission without the mask, the drawn-in stitches were a testament to the high personal cost of such a foolish action. In the spring of 1996, the US Army found itself facing powerful interests determined to have it defend "without a mask."

The contentious debate of those early months centered on a surprisingly unremarkable subject--the lowly land mine. Land mines, anti-personnel (AP) mines in particular, had become (and remain) a problem of global proportions. The basic problem is that while AP mines are cheap and easy to employ, they are extremely expensive and dangerous to remove. As a result, countries around the world, developing countries in particular, have become infested with millions of mines left behind by war--so called residual mines. These residual mines have taken a horrific human toll. In Cambodia, for

example, one out of every 236 people (over 30,000 in all) is an amputee because of encounters with residual mines.[2] Humanitarian action groups the world over have responded to this global nightmare by pressuring governments to ban the use of land mines. In the spring of 1996, the Clinton administration added the US to the growing list of nations that have bowed to the pressure.

On 16 May 1996, President Clinton announced a unilateral ban on the US use of certain land mines. He did this so that the US could "set the example" and "take the lead" in ending the use of land mines around the world.[3] The announcement set off a firestorm of controversy. Critics claimed that the ban would leave US forces at a disadvantage. Some claimed that the nation would pay for the moral high ground of the ban with countless US casualties in future wars. Some questioned whether the US could still perform its assigned missions. In short, these writers were asking whether the US was being asked to "play" without a mask. This question is the focus of this paper.

This paper focuses on the question: will the United States' unilateral ban on anti-personnel land mines significantly impair the effectiveness of US Army countermobility operations during war? As it turns out, the answer is no. The AP mine ban, in its current incarnation, does not pose a threat to US countermobility operations. The paper arrives at this conclusion through a two-step approach.

The first step involves building the background and knowledge base for the analysis. The paper begins building by covering the history of both land mines and the land mine ban. Next, it broadens the base by discussing US mine capabilities. It then presents US mine doctrine, and completes the background with a discussion of

contemporary countermine capabilities. The most important part of the first step is the doctrine section because it provides the basis for the paper's analytic method.

The second step is the analysis of the AP mine ban's effects. The analysis is based on the role of mines and mine warfare under countermobility doctrine. Mine warfare's countermobility tasks are: the disruption of enemy formations and control, the canalization of enemy forces, the protection of friendly forces from enemy assault, and the attrition of enemy personnel and equipment. The analysis draws conclusions about mine warfare's ability to accomplish these tasks without AP mines by exploring examples from mine warfare's historical record. The bulk of the examples come from the Second Battle of El Alamein. This battle is the perfect laboratory for "testing" the effects of an AP mine ban because land mines played a major roll in the battle, but only a small percentage of the mines were of the AP variety.

The analytical method is simple enough. If the historical record demonstrates that mine warfare can accomplish its tasks without AP mines, then the ban is not a problem. If the record shows the opposite, then one must conclude that the ban is forcing the Army "into the goal without a mask." Before one can make any judgment about the ban's effects, however, one must fully understand the ban itself. The first step in understanding the ban is understanding exactly why President Clinton imposed it in the first place.

II. Background

The US ban on anti-personnel (AP) mines is a response to the massive human suffering caused by land mine warfare. The suffering of soldiers, though horrific in itself, is not the main issue. The primary focus of the ban is the suffering land mines inflict on

civilian populations; especially refugees, relief workers, and children. The tragic experience of American relief worker Ken Rutheford is a case in point.

In December of 1993, Ken Rutheford was working in Somalia for the International Red Cross (IRC). On the morning of the 16th, Ken and his Somali colleague Duala jumped into their agency Land Rover and started north on the dusty, poorly defined road to Lugh. After ten bone-jarring minutes, a sharp cracking sound shattered the air. Ken had run over an anti-personnel mine, the deadly legacy of some forgotten clan war. The Rover immediately filled with dust and stopped. Ken, coughing and dazed, looked over at Duala and saw that his legs were smeared with blood. Then he glanced down below his seat. There, next to a large hole in the Rover's floor boards, he saw a bloody, dismembered foot. At first he thought it was Duala's until he saw his own mangled left foot and the bleeding stump of his right leg. Ken freed himself from the car and called for help on his radio while Duala tied tourniquets around his ankles. If not for the help of some gun toting Islamic fundamentalist soldiers and a series of doctors from Nairobi to Denver, Ken would have died.[4] One hundred fifty people, mostly civilians, share Ken's fate <u>every week</u>.[5] To understand how the world came to this state one must understand the evolution of land mine warfare.

People began to explore the military potential of underground explosives soon after the invention of gunpowder. Military engineers first used underground explosives to reduce enemy fortifications. These engineers would dig zigzagging trenches called "saps" up to an enemy's fortress and place large gunpowder charges against the wall to create a breach.[6] Later, engineers learned to dig tunnels or "mines" under an enemy's position and fill the mines with tons of explosives. When detonated, these mines could destroy the

entire position at once.[7] Union engineers used this mining technique in 1864 during the siege of Petersburg, Virginia. They dug a 500 foot long tunnel up to and under a section of the Confederate front line and filled it with kegs of black powder. The charge's explosion created a huge breach in the Confederate line, destroying a fortress and killing almost 300 Confederate soldiers in the process.[8] Mining in this fashion continued into the next century until a grander war, with greater threats, forced underground explosives to evolve.

The introduction of the tank onto the World War I (W.W.I) battlefield spurred the next leap in underground explosives technology. When the British first sent the tank into action at Flers-Courcelette in September 1917, the Germans were concerned. When the British employed them in strength (476 tanks) at Cambrai in November 1917 (with some success), the Germans became terrified. Desperate for an effective countermeasure, the Germans began to bury artillery shells in the ground and detonate them electrically when tanks drove over them.[9] This technique was effective against the lightly armored tanks of W.W.I, but was unreliable due to its reliance on a fragile firing circuit and a vigilant operator. In 1918 the Germans solved the reliability problem by replacing the buried projectiles with a new class of explosives specifically designed to defeat tanks--the contact mine.[10] When employed in large numbers, contact mines presented a permanent, untiring threat against armor attack. Germany, a small country surrounded by enemies, found the force-multiplying effect of mines very appealing, and vigorously pursued mine warfare research during the inter-war years.[11]

As the land mine, a weapon originally conceived as a counter-armor threat, evolved, so did the techniques and technology of counter-mine warfare. The perfection of

mine clearing procedures and magnetic mine detectors greatly reduced the potential of the anti-tank (AT) mine. The Germans, realizing that their armor protection weapon needed protection itself, responded by developing the anti-personnel mine. German anti-personnel mine research flourished during the 1930s. In 1939 the Germans created the dreaded "S-mine", the world's first bounding anti-personnel mine.[12] The S-mine was a steel can 12.7cm high and 10.1cm in diameter. Inside this can was a second, smaller can filled with 350 steel balls and a TNT charge. This inner can was the mine's warhead. When activated, a small charge under the warhead would detonate and cause it to "bound" 1 to 1.5 meters into the air where it would explode with tremendous fragmentary effect.[13] In this way the S-mine could kill or maim anyone within its blast radius rather than just the individual who tripped it. The S-mine demonstrates the especially high level of sophistication achieved by German land mine research, but the Germans were not the only people exploring mine warfare.

The Soviets also studied land mines between the wars and had the opportunity to test their theories of mine warfare during their 1939 war with the Finns. One of the lessons they learned was that even poorly prepared mine fields could delay an enemy's movement due to the fear anti-personnel mines generated. The Soviets also found that one must sow a mine field very densely to create an effective barrier.[14] Few people fully appreciated the implications of this second lesson until W.W.II.

The land mine became a common battlefield fixture during W.W.II. Mines played a minor role in the early European battles of 1939 and 1940 but that changed when the war moved to Africa. The open desert enhanced the already formidable mobility (and thus danger) posed by enemy tanks. Forced to defend against rapid armored attacks in an

environment with few natural obstacles to exploit, defenders began to rely increasingly on mines to disrupt their opponent's maneuver. As mine counter measures improved defenders responded by sowing mines in ever increasing numbers. The Battle of Alamein in October of 1942, where Germans defending under Field Marshal Irwin Rommel created a protective minefield of more than 500,000 mines, exemplifies the scope of mine use during the desert war.[15] While rarely seen on this massive scale again, mine warfare became a staple of the W.W.II battlefield. It was this acceptance of the land mine as a common tool of war that lead directly to the problems of today.

The world has a residual land mine problem today for three reasons: mines are effective, they are cheap and once employed are not generally removed. Land mines effectively disrupt enemy maneuver, so they have tremendous military utility. During the Anzio landing, for example, the presence of mines in the sand dunes and woods beyond the beach delayed the British 1st Division's move inland. The troops would not leave the beach until engineers created lanes in the minefields.[16] While the mines' effectiveness makes them valuable, it is their low cost that makes them plentiful. Small anti-personnel mines sell for as little at $3 a piece, which makes it feasible for even poorly funded militaries to employ them in large quantities.[17] The problem of mass land mine employment is exacerbated by the techniques of countermine operations. Speed is a basic tenet of offensive operations and the need to move fast drives militaries to overcome obstacles quickly. In the case of minefields this means creating breach lanes through the minefield rather than clearing all the mines away. The logic of the situation is unavoidable. Militaries want mines because they work, they use them in large quantities because they are cheap and the focus on breaching rather than clearing leaves mines littering the

battlefield long after the armies go home. As long as these three conditions hold the world will have a residual mine problem.

Residual mines produce catastrophic effects. They render large tracts of agricultural lands, road networks and vital sources of potable water virtually inaccessible.[18] Residual mines delay resettlement and create extremely dangerous conditions for returning inhabitants and relief workers (e.g., Ken Rutheford). The scope of the problem is staggering. The US State Department estimates that there are over 85 million uncleared land mines in 62 countries around the world.[19] Worldwide outrage over the situation fostered a strong movement against land mines by many governments.

The anti-land mine crusade achieved official status with the United Nations (UN) Convention on Prohibitions or Restrictions on the use of Certain Conventional Weapons (CCW) in 1980. Representatives of more than 50 nations signed the convention that, among other things, calls for a virtual ban on land mines.[20] The US is a signatory of the convention but has not ratified it. Both the Reagan and Bush administrations pledged to support the ban but never followed through on it.[21] Those administration's refusals to act on the ban motivated a few in Congress to take up the anti-mine banner themselves.

Senator Patrick Leahy (Vermont) and Representative Lane Evans (Illinois) are the main congressional champions of the land mine ban. One of the few successes in their fight against land mines was a one-year moratorium on the sale and transfer of anti-personnel mines from the US that they pushed through Congress in 1992.[22] Their hopes for CCW ratification were lifted in 1992 when president-elect Clinton announced that he would support a world wide ban on land mines, but this hope soon faded. Despite the

initial pledge, the Clinton administration did nothing about the ban for three years. It took the threat of harm to American soldiers to get things moving.

The US involvement in Bosnia provided the impetus for the final push for a land mine ban. Bosnia is strewn with residual mines. When US troops hit the ground, fear for their safety brought the land mine debate to the fore.[23] Pressure from the media, Congress and the public for the administration to deal with the land mine issue began to mount. Newspaper editorials called for the US to take the lead in banning mines.[24] A group of former prominent Generals and Admirals published an open letter to President Clinton renouncing the use of land mines.[25] In spite of all the attention on the issue, it took two final events to solidify administration support.

Madeline Albright, the US Ambassador to the UN, visited Angola in March of 1996. She met thousands of amputees during her visit, most the victims of residual land mines. Her experience spurred her to action. Upon her return to the US, Ambassador Albright wrote a letter to administration officials asking them to reconsider the US position on the land mine ban.[26] The release of her letter coincided with another significant event; a residual mine killed a member of the US peacekeeping force in Bosnia. Albright's powerful letter coupled with a US soldier's tragic death finally settled the issue. After a few months of considering various proposals President Clinton announced, on 16 May 1996, that the US would unilaterally end the use of some anti-personnel land mines. This action was of clear significance to the Army.

The land mine ban announced by President Clinton is a partial ban on these weapons. The ban concerns only anti-personnel land mines, specifically the "dumb" or non self-destructing type. The ban requires the military to immediately cease use of dumb

anti-personnel mines except in training and in the unique case of the Korean demilitarized zone (DMZ). It goes on to require the total elimination of dumb anti-personnel mines from the US inventory (some four million mines) by 1999. The ban does not effect "smart" (self-destructing) anti-personnel mines or anti-tank mines of either type (dumb or smart).[27] The distinction between "smart" and "dumb" mines is clearly central to the ban. To understand how this distinction impacts the Army, one must be familiar with the Army's current anti-personnel land mine capabilities.

III. US Army Anti-Personnel Mine Capabilities

US Army mines fall into two broad categories, conventional and scatterable. Each of these categories contains a variety of anti-personnel and anti-tank mines. This treatment of US mine capabilities will examine the conventional mine inventory first since the mines in this category are the only "dumb" mines in the US inventory, the focus of the ban. It will then cover US scatterable mines--all of which are "smart"--for completeness and use in later analysis. Anti-tank mines are not covered in detail since they are not included in the ban.

Any mine that is hand laid and requires manual arming is a conventional mine.[28] Conventional mines offer four advantages over the scatterable mines in the US inventory. The first is that once they are emplaced and armed, conventional mines provide a permanent, lethal effect. Second, the variety of fuze and warhead combinations available allows one to create tailored killing effects. Third, their manual deployment permits one to lay them in specific, controlled patterns (including burial). Finally, the deploying unit can recover and reuse conventional mines unless they have fit the mines with anti-handling

devices (AHDs). Conventional mines also have weaknesses. Manual mine deployment is both time and labor intensive, two commodities that are usually scarce on a battlefield. For example, it took over three months to lay the 400,000 mines (2700 AP and 2400 AT mines per mile) that went into the defense of the Kursk Salient in 1943.[29] The fact that one can recover conventional mines, listed as a positive feature above, is also a weakness. Once one employs these mines, anyone that knows how, can recover them. Thus, a unit that employs conventional mines runs the risk of having a savvy enemy take and then use their own mines against them. Despite these shortcomings the Army recognized the tactical value of conventional mines and produced several types to provide itself with a wide variety of land mine capabilities.

The Army has three conventional anti-personnel mines. They are the M14 nonmetallic, blast (simple explosion) mine, the M16A2 fragmentation mine and the M18A1 directional, fragmentation mine. The following discussion outlines some key characteristics of these mines.[30]

The M14 is a small cylindrical mine with a pressure activated fuze. The M14 produces very little fragmentation and is designed to incapacitate rather than kill its victims with its blast. Its low metallic content makes the mine very difficult to detect with magnetic mine detection equipment. Its small size and light weight make it easy to transport and use in large quantities.

The M16A2 is a bounding, fragmentation mine that is quite similar to the German S-mine of W. W. II. It weighs eight pounds and is detonated by either pressure or a trip wire. When detonated, the mine throws its warhead chest high into the air, and then

explodes with fragmentary effect. The fragmentation produces a thirty meter casualty radius. The M16A2 was designed to attack groups rather than individual soldiers.

The M18A1 (Claymore) is a directional fragmentation mine. The mine is activated by command or tripwire. When activated it launches 700 steel balls to its front in a sixty degree arc. It has a casualty radius of 100 meters to its front and sixteen meters to its rear. Like the M16A2, the M18A1 was designed for use against groups of soldiers. Table 1 below is a recapitulation of conventional anti-personnel mine data.

TABLE 1

CHARACTERISTICS OF US CONVENTIONAL MINES[31]

Mine	Type	Fuzing	Force to Detonate	Warhead	AHD	Shape	Height	Width	Weight
M14	AP	Pressure	25 lbs	Blast	No	Cylinder	1.56 in.	2.19 in.	3.3 oz.
M16A2	AP	Pressure TripWire	8 lbs	Bounding Frag	No	Cylinder	4.7 in.	4 in.	8 lb.
M18A1	AP	Command Trip Wire	NA	Directional Frag	No	Curved Block	approx. 4 in	approx. 6 in.	3.5 lb.

With the coverage of conventional mines complete, the analysis now turns to the Army's family of scatterable mines.

Any mine in the US inventory that is delivered by artillery, aircraft, vehicle or ground dispenser system is a scatterable mine.[32] Scatterable mines offer three advantages over conventional mines. First, they afford US commanders a means of deploying mines in areas that they do not control such as enemy held or contaminated terrain. Second, scatterable mines can be deployed quickly compared to conventional types. It would take an experienced engineer squad about ten hours to lay in a 300 meter long conventional

minefield with a 0.5 mine/meter linear density.[33] Linear density is the number of mines one would encounter along any one meter wide path straight through the minefield. On the other hand, one soldier with a Volcano mine dispenser system could deploy a similar minefield (277 meters long and 0.86 mine/meter linear density) in minutes.[34] Finally, scatterable mines offer commanders increased tactical flexibility. Since all scatterable mines in the US inventory feature timed self-destruction mechanisms, a commander's scatterable mine obstacles do not become permanent impediments to his future maneuver. These characteristics make scatterable mines very attractive weapons but like all weapons they have limitations.

Scatterable mines have four main limitations. First, they are always surface laid so they can only produce a surprise effect in limited visibility situations. Second, they come with fixed fuze-warhead combinations so they can not produce the same variety of killing effects that conventional mines can. Third, their automatic self-destruction feature makes them unsuitable for long term or permanent effect situations (fifteen days is the longest duration for a US scatterable mine). Lastly, the random nature of scatterable mine deployment prevents tailored emplacement or exact mine location recording. This final limitation is at the heart of why scatterable mines of all types are specifically included in the CCW and remain a target for future banning. Limitations or not, the Army uses a wide variety of scatterable mines.

The Army has five scatterable anti-personnel mines in its inventory. They are the M72 area denial artillery munition (ADAM), the M67 ADAM, the M77 modular pack mine system (MOPMS), the Volcano AP mine and the M86 pursuit-deterrent munition

(PDM). These mines have very similar characteristics, their biggest differences being their manner of deployment and life cycles.[35]

The M72 and M67 are small wedge shaped bounding anti-personnel mines. They are deployed 36 at a time from special 155mm artillery rounds. Like all scatterable anti-personnel mines, they are activated when something disturbs one of their self deploying trip wires. The only difference between these two mines is their duration: four hours for the M67 and 48 hours for the M72.

The M77 is a cylindrical, blast-fragmentation mine. Each MOPMS dispenser deploys four M77 mines along with 17 M76 anti-tank mines. The MOPMS unit is a man-portable ground unit that contains 21 mines in seven internal launch tubes. The MOPMS ground unit can be activated by a M71 remote control unit (RCU) or electrically. Once activated, the MOPMS creates an instant, 70 meter wide minefield. The M77 mine has a four hour duration but unlike other scatterable mines the operator can use the RCU to recycle the mines three times. This gives the M77 a 16 hour potential duration.

The Volcano's anti-personnel mine is a cylindrical, blast-fragmentation mine. The Volcano dispenses one of these mines for every group of five AT mines. The Volcano dispenser can operate from a ground vehicle or a helicopter. The Volcano's mines are unique in that the operator deploying the mines gets to choose their duration (4 hrs, 48 hrs or 15 days) at the time of deployment.

The M86 PDM is really a hybrid between conventional and scatterable mines. It is a small, wedge shaped device that looks like an ADAM munition with a hand grenade fuze attached to the top. It is activated in the same manner as a hand grenade. Once the operator pulls the pin and releases the PDM, it self arms and deploys tripwires in the

manner of a scatterable AP mine. The PDM is technically a conventional mine because it is deployed by hand, but it is included here with the scatterable mines because of its functional characteristics. It is a self-destructing munition with a four hour duration; a fact that excludes the PDM from the anti-personnel mine ban. Table 2 is a recapitulation of scatterable mine characteristics.

TABLE 2

CHARACTERISTICS OF US SCATTERABLE ANTI-PERSONNEL MINES[36]

Mine	Delivery System	Fuzing	Warhead	AHD	Self-destruct time	Shape
M72	155mm Artillery	Tripwire	Bounding Frag	20%	48 hr	Wedge
M67	155mm Artillery	Tripwire	Bounding Frag	20%	4 hr	Wedge
M74	MOPMS	Tripwire	Blast Fragment	No	4 hr (4 times)	Cylinder
Volcano	Ground/ Air	Tripwire	Blast Fragment	No	4/48 hr 15 days	Cylinder
M86	Manual	Tripwire	Bounding Frag	All	4 hr	Wedge

The foregoing discussion concentrated on the types of anti-personnel mines available to the Army and the capabilities and limitations of these devices. While this information is fundamental to understanding the impact that the anti-personnel mine ban will have on countermobility operations it is not enough. Before one can analyze the ban's effects, one must understand the way that the Army employs anti-personnel mines.

IV. Anti-Personnel Mines and US Army Countermobility Doctrine

Field Manual 100-5 Operations identifies a set of nine "Principles of War" that form the basis of US Army doctrine. While these principles are not guarantors of military success, they represent traits that are common to successful military operations. One of the nine principles is *maneuver,* which FM 100-5 defines as "the movement of forces in relation to the enemy to gain a positional advantage."[37] Given that maneuver is a proven component of military success, it is not surprising that armies work to deny their opponents the benefits of maneuver through countermobility operations. This section explores countermoblity doctrine and the role that anti-personnel mines play in countermobility operations.

Countermobility doctrine focuses on the use of obstacles to delay, restrict or stop enemy maneuver. The doctrine recognizes two basic categories of obstacles: existing and reinforcing.[38] Existing obstacles are those obstructions that are present on the battlefield before military operations begin. There are two types of existing obstacles: natural and cultural. Natural obstacles are those that nature provides such as rivers, cliffs, and swamps. Cultural obstacles are man-made impediments to movement like towns and railroad embankments.[39] The art of countermobility lies in recognizing the military potential of the existing obstacles on a battlefield, and enhancing them to support one's tactical plan with reinforcing obstacles.

Reinforcing obstacles are obstructions, created through military effort, designed to connect, enhance or extend existing obstacles. Tank ditches, concertina wire fences and road craters are all examples of reinforcing obstacles.[40] The main value of reinforcing obstacles is that they slow enemy maneuver, increasing the time that the enemy spends

exposed to one's weapons. Thus, reinforcing obstacles play an indirect role in destroying the enemy. One category of reinforcing obstacles, the land mine, has additional value in that it can directly destroy or incapacitate the enemy. Because of this additional capability, countermobility doctrine recognizes mine warfare as a distinct branch of countermobility operations.[41]

Mine warfare serves four primary purposes in countermobility operations. These purposes are: the disruption of enemy formations and control, the canalization of enemy forces, the protection of friendly forces from enemy assault, and finally, the attrition of enemy personnel and equipment. Mine warfare accomplishes these things by applying mines in small groups as "nuisance" mines, or in large groups as minefields.[42]

Nuisance mining is designed to undermine an enemy's will. Such mining introduces unexpected danger into seemingly safe situations and makes soldiers excessively cautious. The Germans refined the art of nuisance mining during W.W.II. One method they used during the Italian campaign was the nuisance mining of fording sites. The Germans would place a few mines at fording sites during the dry summer months. Later, winter rains swelled the streams and obscured the mines. This nuisance mining worked well. The fear of hidden mines quickly turned every stream crossing, an event which should have taken minutes, into a long, slow mine clearance operation.[43] While nuisance mines serve the purposes of countermobility mainly through psychological effect, mines employed in mass as minefields act as physical impediments to maneuver.

There are three basic types of minefields: phony, protective, and tactical.[44] Each serves a distinct purpose, but successful commanders use the three in combination. The simplest of the three is the phony minefield.

As their name suggests, phony minefields are nothing more than deceptions. The purpose of a phony minefield is to get one's opponent to waste some of his breaching assets (and time) on a useless target. Phony minefields also have the potential--if used frequently--to make one's enemy complacent. This can increase the enemy's losses when he comes across real minefields in the future.[45] Phony minefields work best if they are obvious, and look like a real minefield. The protective minefield, on the other hand, works best when it goes unnoticed.

Armies use protective minefields to safeguard friendly forces, equipment and installations against enemy assault. These minefields often serve as the "last line of defense" against the enemy. Units typically employ protective minefields when defending a specific location against a superior enemy force. The concentric belts of densely sown minefields that helped protect Tobruk's British Commonwealth defenders from the Afrika Corps in 1941 are examples of protective minefields.[46] There are two kinds of protective minefields: hasty and deliberate. The difference is usually a matter of degree, reflecting the amount of time and resources a unit has to establish the minefield.

A unit typically lays a hasty protective minefield as part of its defensive perimeter. It uses the mines it has on hand to prevent movement along the best avenues of approach into its position. Hasty protective minefields are generally surface laid just beyond hand grenade range. When it moves, the unit recovers its mines for use at its next position.[47]

Deliberate protective minefields serve the same purpose as the hasty type, but display some differences due to the greater amount of time and resources available for their construction. The first difference is that the mines in a deliberate minefield are buried to increase their effectiveness. The next is that they are usually sown in much greater

numbers than in hasty situations. Finally, the mines in a deliberate protective minefield are typically laid in specific patterns, designed to create the greatest effect against an assaulting enemy. The patterns used in hasty minefields are usually much less sophisticated. While protective minefields provide valuable protection against an enemy's final assault, they have little effect on his overall maneuver. One way for a defender to influence an attacker's maneuver is through use of tactical minefields.[48]

Tactical minefields provide the defender the same benefit that maneuver provides the attacker: the means to gain positional advantage over one's opponent. If the attacker can move where he likes, he has the advantage. If the defender can use tactical minefields to dictate the attacker's direction and form of maneuver, the advantage and initiative shift to the defender. Tactical minefields serve two of mine warfare's countermobility functions: they disrupt enemy formations (and control) and canalize the enemy to provide advantageous shots for friendly weapons systems.

Tactical minefields constructed in groups across an enemy's avenue of approach serve to disrupt his attack formations and interrupt his control. This is critical because an enemy who cannot maintain formations or control cannot concentrate his units. If an attacker cannot concentrate, he cannot mass his forces against the defender. When one denies an attacker the ability to mass where he chooses, one denies him the fundamental advantage of the offense. The power of formation-breaking minefields is magnified when coupled with minefields that turn the attacker in front of the defenders' weapons.

Tactical minefields that extend obliquely from the edge of an attacker's avenue of approach can canalize him in a direction of the defender's choice. If these minefields are situated so that the canalization occurs directly in front of friendly weapons systems, the

enemy will present those systems with lucrative flank and rear shots.[49] It is the ability of canalizing minefields to steer an attacker in the direction that the defender wants him to go that transfers the initiative from attacker to defender.

The foregoing discussion demonstrates that the minefield, in its several forms, is the principle weapon of mine warfare. If mine warfare is to serve its role in countermobility operations, minefields must be able to accomplish the four purposes of mine warfare listed earlier. Therefore, if the ban on conventional anti-personnel mines prevents mine warfare from meeting these four purposes, one must conclude that the ban significantly degrades the US Army's countermobility capability. However, to make such an analysis, one must first understand the methods available to defeat minefields.

V. Contemporary Countermine Practices

The duel between mine warfare and countermine operations began when Germans planted the first contact mines on a W.W.I battlefield. Since that time, every innovation in mine warfare has lead to a countermeasure that, in turn, spawned a further mine innovation. Armies countered the original AT mines with manual probing and clearing techniques. Mine warfare responded to the success of manual clearing with the anti-personnel mine and anti-lift devices (booby traps). The electronic mine detector, a device that uses a magnetic field to "sense" the presence of buried metal objects, gave soldiers the ability to safely locate buried mines without probing. Mine producers countered the mine detector with non-metallic mines (usually made of plastic) that contain too little metal for a mine detector to register. The cycle of innovation and reaction has continued through

the years to the present. This section explores the methods armies currently use to defeat anti-personnel mines and minefields.

An army conducting offensive operations--where speed and mobility are critical--defeats an enemy minefield by breaching lanes through it. There are three basic methods available to conduct such breaching operations. They are: manual breaching, explosive breaching, and mechanical breaching.[50] The following example from the Gulf War demonstrates how armies use these methods in battle.

At midnight on Sunday, 24 February 1991, marines of the 1st Marine Division's Task Force Ripper began their advance into Kuwait during Operation Desert Storm. They knew, as they crossed the border, that they would have to breach two protective minefields that lay just ahead. Specially trained units of Saudi sappers had infiltrated into Kuwait and manually cleared 75 mines to breach one lane the previous night, but it was not enough. The marines recognized that they would have to breach additional lanes to pass the entire division quickly. When the marines reached the minefield's leading edge, their engineers fired rockets that towed line charges (long hoses filed with explosives) across the minefield. Once in position the line charges exploded, detonating or pushing aside mines to create tank-width "lanes" through the minefield. The first vehicles to drive down the lanes were mine-plow bearing tanks sent through to "proof" the lanes by clearing out any mines the line charges may have missed. It was a prudent decision because the plows dug up and pushed aside large numbers of mines as they went. Despite these careful procedures, the minefield remained dangerous. On one lane, for example, the tank immediately following the mine plow tank struck an AT mine that blew off one of the tank's treads. The marines repeated this procedure at the second minefield and then

continued on towards Kuwait City.[51] This example of a successful breaching operation sets the stage for a more detailed examination of contemporary countermine techniques.

Manual breaching is the oldest countermine technique. It is a slow, dangerous process that exposes soldiers to the full effects of the mines they are clearing. There are three phases to manual breaching: clearing the minefield of trip wires, detecting the mines and then physically removing (or at least disarming) them. Soldiers begin a manual breach by throwing a grappling hook (or other heavy object) with a rope attached into the minefield. They then drag the hook back through to set off any trip wires in the minefield. Once the surface is clear, the soldiers begin the detection phase. If the mines are metallic, soldiers can locate them with magnetic mine detectors. If they are non-metallic, the detection team must resort to the highly dangerous method of physically probing the ground. As the detection team locates the mines, they mark them. Then a demolition team, that follows the probers down the lane, removes or destroys the mines. Manual breaching remains the only way to guarantee the total removal of mines from a breach lane.[52] Unfortunately, manual breaching takes so long that it is unsuited for the rapid pace of modern warfare; but there are alternatives. Explosive breaching is one solution to the problem of time-consuming, manual breaching.

Explosive breaching is the fastest way to breach lanes through minefields. The idea behind an explosive breach is to insert a powerful explosive device into a minefield, and then detonate it to destroy or displace any mines near the device. This method is designed to produce an "instant" lane through the minefield that the moving force can then exploit. There are three main devices that armies use to conduct explosive breaching: field artillery, the Bangalore torpedo, and the explosive line charge.

The least dangerous way (from the breaching force's perspective) to explosively breach a minefield is to saturate it with artillery fire. If one bombards an area sufficiently, a high percentage of the emplaced mines will be destroyed or hurled aside. The Arabs used this technique very successfully against Israeli minefields during the 1973 war.[53] While this method worked well in the sandy terrain of the desert, it would likely prove less effective in more substantial soil. Moreover, such an intense bombardment would certainly leave the ground very difficult to traverse, and possibly salted with unexploded artillery rounds (duds). Thus, this technique presents the breacher with the risk of exchanging one obstacle for another. Fortunately, there are more reliable methods for using explosives to achieve instant breaches.

The Bangalore torpedo is an old, yet effective, explosive breaching device. The Bangalore consists of sections of pipe filled with explosives. A breaching team guides the first section of the Bangalore into the minefield and then moves it through by sticking the head of the next section into the tail of the preceding one and pushing both forward. The team continues to add sections and push the torpedo forward until the Bangalore spans the entire minefield. Once the torpedo is across, the breachers detonate its explosive core to create a lane. While the Bangalore torpedo is faster than manual breaching, it has several shortcomings. The device is heavy and clumsy to work with (which makes it relatively slow to use), and the breachers are exposed to enemy fire for long periods while they extend it across the minefield.[54] The search for a faster and safer way to achieve an instant breach lane led to the development of the explosive line charge.

The explosive line charge consist of a rocket connected to a long, thick hose filled with (or a chain covered with) explosives. When fired, the rocket arcs over the minefield,

pulling the line charge across after it. Once it hits the ground, the operator detonates it, producing the same effects as the Bangalore torpedo. While a line charge can produce a lane very quickly, it has some limitations. Line charges are so heavy that they must be operated from a vehicle or a trailer, which limits their use to mechanized formations (although some armies do have small, man-portable versions for use against AP minefields in restrictive terrain). Line charges are also hard to control, which makes them difficult to place exactly where desired. The problem with achieving precise placement, coupled with the line charge's tendency to "snap back" a little once the rocket reaches the line's maximum length, means that they often leave portions of deep minefields unbreached. Line charges also rarely achieve 100 percent mine clearance, especially when employed against mines with the new "double impulse" fuzes. As the name suggests, a double impulse fuze requires two physical impacts to detonate. A line charge will often provide the first impulse leaving the first vehicle to traverse the lane to provide the second.[55] The limitations of explosive breaching devices compel armies to supplement them with mechanical breaching devices.

Mechanical breaching involves the use of a vehicle mounted device to eliminate mines through direct, physical action. The main devices that modern armies use to conduct mechanical breaching are the mine plow, the mine roller and the mine flail. These devices usually operate from the front of a tank or armored engineer vehicle. This is desirable for two reasons. First, the vehicle's armor provides the breach team with protection during the breach. Second, these devices are so heavy that large, tracked vehicles are the only things powerful enough to support them.[56] The most reliable of the three mechanical breaching devices is the mine plow.

A mine plow is a large, wedge-shaped device that digs a trough in the ground as the vehicle it is attached to moves forward. The plow digs up and pushes aside the mines it encounters. This is a relatively safe process, since most mines are pushed aside rather than detonated, but one that puts tremendous strain on the vehicle pushing the plow. Mine plows work well in loose or sandy soil, but often prove difficult to use in dense or rocky soil.[57] The need for mine clearing capability in all soil conditions creates a need for other mechanical breaching devices, such as the mine roller.

A mine roller is a set of massive, steel disks (arranged in a manner resembling a farmer's disk harrow) that roll over and detonate mines in the clearing vehicle's path. The disks are usually gathered into two clusters, with one cluster positioned to clear the way for each of the vehicle's treads. Since the mine roller rolls over the ground rather than digging through it like the plow, it works in tough, densely packed soil that could stop a plow. One problem with mine rollers is that they are extremely heavy, which makes them hard to maneuver and extremely difficult to push through soft or muddy ground. Another problem is that the roller's method of clearing mines (detonation) is hard on the roller, and one must expect it to be destroyed by repeated mine blasts.[58] One thing to keep in mind when considering the mine roller's destruction, however, is that it is better to lose it than to lose people during manual clearing. The shortcomings of both mine plows and mine rollers have lead to renewed interest into one of the oldest mechanical breaching devices, the mine flail.

The mine flail consists of long, weighted chains attached at one end to a rotating drum. The drum is held away from the front of the clearing vehicle by two long arms. When the vehicle moves forward, the drum rotates causing the chains to whirl and beat the

ground under the drum. The flail has regained popularity mainly because the repeated strikes it creates enable it to defeat double-impulse mines. The flail also has limitations. Flails must move slowly to provide good ground coverage. Such slow movement makes them vulnerable to direct fire when breaching. Flails also have trouble when operating on rough terrain, as the chains tend to miss mines in depressions or ditches. Modern flails have sensors that adjust the drum height to reduce this problem, but it is not eliminated.[59] The lesson in all of this is that minefield breaching is a difficult operation, and one that requires a variety of redundant systems for success.

Thus far, this paper has covered the genesis of the anti-personnel mine ban, and the anti-personnel mines in the US inventory. It has also covered the ways in which the Army employs mines during countermobility operations, as well as the methods available to defeat mines. With this groundwork laid, the paper now moves on to analyze the impact the ban on conventional anti-personnel mines will have on countermobility operations.

VI. Alamein: War Without Anti-personnel Mines

History rarely provides examples that allow a researcher to examine the effects of one variable or factor in isolation. Occasionally, however, history comes through with an event that meets the researcher's needs exactly. For this analysis, the Second Battle of El Alamein (Alamein) is such an event.

From 1940 through 1943, the British fought the Germans and their Italian allies for control of North Africa. The fighting in North Africa was marked by long, sweeping campaigns where one side would drive the other across the theater until it overextended its lines of communication and culminated. After a short pause, the former defender

would then push its opponent all the way back to the start point. A key characteristic of the fighting in North Africa was that the desert expanse to the South always provided the attacker with an open flank to turn. The desert near Alamein in Egypt, however, was different. There the Qattara depression, an impassable quagmire forty miles from the coast, provided the defender an unassailable southern flank.

General Erwin Rommel had spent the summer of 1942 trying to drive the British out of North Africa for good. His plan was frustrated when the British stopped him, imposing tremendous loses on him, at the battle of Alam Halfa. Outnumbered, out-equipped and critically short of supply, Rommel realized that he could no longer fight a mobile war and win. He decided that the Alamein position was his only hope for stopping the inevitable British counter attack. He spent the next two months turning the desert south of Alamein into a sea of minefields covered with interlocking fires and fortified defensive positions. The Germans laid the mines in two long belts, three thousand meters apart, from the coast to the Qattara. They connected the belts at intervals with East-West running minefields placed to steer attackers into the engagement areas of anti-tank guns. It is this minefield defense that makes Alamein such a valuable example for this analysis.[60]

There are three reasons why Alamein fits the needs of this analysis so well. First, it was a struggle between two well matched and “modern” (for the day) mechanized forces. Both sides had sophisticated tactics and equipment, and the attackers (the British) employed many of the minefield breaching techniques used today including manual, explosive and mechanical breaching.[61] These facts are important because they set the context for comparison with current (1996) warfighting. Second, the battle occurred in the Egyptian desert. While this desert is not an utterly featureless plain, it has very few

existing obstacles for a defending force to exploit. This means that the massive mine belts provided virtually all the countermobility effort for the Germans, and allows the analyst to attribute any maneuver disruption effects directly to the minefields. Third, and most importantly, the Alamein battlefield was virtually free of anti-personnel mines. Of the 500,000 mines Rommel used to create his "mine garden," less than 14,000 (3 percent) were anti-personnel mines.[62] Given that Rommel wanted to use AT and AP mines at a three to one ratio, one can understand why he felt he was without AP mine support.[63]

Second Alamein--a battle centered on land mines, bereft of other obstacles to cloud the analysis, a battle between "modern" belligerents, and virtually free of AP mines--is the perfect vehicle for an analysis of an AP mine ban's effects. The following sections will draw on the record of Alamein to answer questions about the effectiveness of mine warfare without AP mines.

VII. The Ban's Effect on Disruption of Enemy Formations and Control

This section examines whether the anti-personnel mine ban will hinder mine warfare's ability to disrupt an enemy's formations and control. The section begins by describing the specific techniques mine warfare uses to disrupt formations and control. It then "tests" these techniques in the laboratory of history. The section ends by drawing conclusions about the ban's impact on countermobility operations.

US mine warfare doctrine identifies two types of tactical minefields for disrupting enemy formations and control: the disrupt effect and fix effect minefields. These minefields are not meant to force the enemy into breaching operations. The basic idea

behind these minefields is to allow the enemy to move in the direction he wants to go, but not in the manner that he planned to do it.

Disrupt effect minefields consist of rows of mines in depth, laid across half of an enemy's avenue of approach. The rows are oriented perpendicular to the enemy's anticipated direction of travel. When the enemy--spread out in his assault formation--runs into the disrupt effect minefield, the units confronted with the minefield are forced to make a choice. They can go around the minefield by following the unencumbered units, breach it, or bull through the mines. The choice they make is immaterial to the defender because they all accomplish the same thing; the break-up of the attacker's formation. When this happens, the attacker presents himself to the defender piecemeal rather than in strength, allowing the defender to concentrate his weapons against the strung out enemy. The critical thing to note about disrupt effect minefields is that since they are not meant to be breach-resistant, doctrine *does not call for anti-personnel mines in their construction.*[64]

Fix effect minefields consists of rows of mines in depth that span the enemy's entire avenue of approach. These rows are arrayed in a checkerboard pattern, which creates winding, mine-free lanes through the minefield. The objective of the fix effect minefield is to slow the enemy down in a critical area (usually the defender's engagement area) to give the defenders additional time to acquire and engage their targets. This arrangement defeats the enemy commander's control by preventing him from maneuvering his forces to provide coordinated fire against the defenders. It is worth noting that in forcing the attacker to move in lanes the fix effect minefield also disrupts enemy formations. It is not surprising, then, that the fix effect minefield confronts the enemy with roughly the same choices that the disrupt effect type did: negotiate the lanes, bull through

or breach. Any of the choices satisfies the defender because they all slow down the attacker. Again, the critical fact that doctrine *does not call for anti-personnel mines in the construction of fix effect minefields* stands out.[65] The Germans demonstrated the concepts behind the disrupt effect and fix effect minefields at Alamein.

The Sherwood Rangers tank battalion learned a bitter lesson about how minefields can disrupt formations and control, during the first day of Alamein. The British plan called for the 10th Armored Division (including the Rangers) to follow the New Zealand Infantry Division through the northern mine belts, and capture intermediate objectives just beyond the Mitierya Ridge. The attack began well. The infantrymen were able to fight their way through the minefields making up Rommel's two mine belts with relative impunity, due to the scarcity of anti-personnel mines. The tanks, however, had to wait until the engineers breached lanes before they could move. The engineers completed four lanes through the first belt by 0430. Shielded by the darkness, the Rangers used these lanes to move into the large gap between the mine belts without incident. Artillery fire and intense resistance from German combat outposts covering the second belt kept the engineers from breaching these minefields until 0600. The Rangers drove into the new lanes and found themselves trapped, during daylight, in the main engagement area of a German AT gun screen. The lanes effectively turned the second mine belt into a fix effect minefield, forcing the British to choose from the three desperate options mentioned earlier. At first they chose to stay in the lanes, and six tanks were hit within five minutes. Next they tried to bull through the mines and deploy, which very quickly brought the total of burning tanks to sixteen. They finally withdrew behind the Mitierya Ridge.[66]

The preceding vignette confirms the validity of mine warfare doctrine regarding disrupt and fix effect type tactical minefields. Specifically, it demonstrates that properly prepared disrupt and fix effect minefields can destroy an attacker's formation and control *without anti-personnel mines*. As long as these minefields are covered by fire and properly prepared, they will force an attacker to slow down, piecemeal his units and surrender the ability to concentrate against the defender. This result is important because it shows that since disrupt effect and fix effect minefields do not require anti-personnel mines to be effective, the anti-personnel mine ban will not diminish mine warfare's ability to disrupt an attacker's formation and control.

VIII. The Ban's Effect on Canalizing Enemy Movement

US mine warfare doctrine identifies two types of tactical minefields designed to dictate an enemy's direction of movement: the turn effect and block effect minefields. These minefields face a difficult task since it is much harder to deflect an enemy from his intended path than it is to merely disrupt his formation. The attacker jealously guards his ability to determine the point of attack since this is the main source of the his advantage. Forcing an attacker from his desired route is extremely expensive, in terms of the effort and resources required, but is well worth the price. The cost is justified because driving the attacker from his intended route is how the defender captures the initiative.

Turn effect minefields consist of rows of mines extending obliquely from one edge of the attacker's avenue of approach. Each subsequent row the attacker encounters is offset farther into his avenue of approach at an increasingly oblique angle to his direction of movement. Effective turn effect minefields display three traits. The minefields must

change orientation gradually, so that the enemy commander does not realize that he is being redirected. The minefield must be easy to bypass in the direction the defender wants the attacker to go, and the bypass must be obvious. Finally, the minefield's leading edge must be tied into highly restrictive or heavily defended terrain to prevent the enemy from bypassing the minefield on the wrong side. If the defender covers such a turn effect minefield with coordinated direct fires, he will be rewarded with devastating flank and rear shots as the minefield steers the attacker across the defender's front. It is important to note that as in the case of the disrupt and fix effect minefields, doctrine *does not call for antipersonnel mines* in the construction of turn effect minefields. The following example showcases the turn effect minefield's capabilities.

Rommel integrated turn effect minefields that "...shepherded attackers onto concealed positions"[67] all along his mine belts at Alamein. The British 1st Armored Division's experience on the battle's second day provides a case in point. The 1st Armored was following the 51st Highland (Infantry) Division through the second mine belt toward the armor's objectives on Kidney Ridge. The infantry moved directly towards the ridge, but the armor found itself being gradually steered south by turn effect minefields. Any attempts they made to correct their direction proved costly. At one point, a regimental headquarters lost three tanks because the minefield they were skirting had a shape "...difficult to determine." The minefield's shape was confusing because it was encroaching across their avenue of approach by stages. The division eventually found itself 1000 yards off of their intended direction, driving across the front of a dug-in 88mm gun battery. The guns quickly mauled the tanks, and the 1st Armored Division soon withdrew with heavy losses.[68]

The 1st Armored Division's bitter experience, common at Alamein, suggests that mine warfare doctrine is correct regarding turn effect minefields. These minefields can cause an attacker to change directions without the use of anti-personnel mines. Thus it appears that a defender's ability to canalize an enemy is not threatened by a ban on conventional anti-personnel mines. Occasionally, however, a defender needs to completely stop rather than merely turn an attacker. If a defender needs to deny an attacker access to a particular area, he must use a block effect minefield.

Block effect minefields are designed to prevent an attacker from moving in a particular direction, or at least to make such movement extremely costly.[69] These minefields consist of multiple overlapping rows of densely seeded mines, covered by intense fire and observation. They are highly resource intensive, in terms of both materiel and effort, but it is just this intense concentration of destructive potential that makes them effective. Block effect minefields only work if they are breach resistant. To be breach resistant, these minefields must be covered with both direct and indirect fires. They must also include large quantities of anti-personnel mines, booby traps or anti-handling devices to protect the anti-tank mines.[70] When an attacker comes upon a well-prepared block effect minefield, he is faced with two choices: go a different way, or breach a path through at horrific cost. These choices are exactly those Montgomery faced at Alamein.

The German mine defenses at Alamein, when taken as a whole, become a massive block effect minefield. Such an obstacle, anchored on the Mediterranean Sea in the North and the Qattara Depression in the South, was the only method available for Rommel to counter the British materiel superiority. Rommel was determined to "...prevent the British from breaking through our line at all costs," and so spared no resource or effort in

building the minefield that was to help him achieve his goal.[71] He had few anti-personnel mines at his disposal, but tried to make up for this shortfall with booby trapped bombs and artillery shells.[72]

Unfortunately for Rommel, his best efforts fell short and the British eventually got through his minefields. Rommel's problem was that the German minefields lacked the high density of anti-personnel mines doctrine requires. This allowed the British infantry to move through the minefields virtually at will. Such unrestricted movement gave the British the ability to secure the minefields so that their sappers could work with minimal harassment from German infantry. Protected by infantry and essentially unmolested by anti-personnel mines, the sappers were able to breach lanes with relative impunity. The key point here is that even with excellent planning, brilliant preparation and superb execution on the part of the Germans, the British were able to force their way through. This is the first example in which the lack of anti-personnel mines appears to have had a negative impact on the German's Alamein defenses. The question is, will the anti-personnel mine ban produce similar negative effects today?

The answer to the above question is no. While Rommel had almost no AP mines, the current ban does not leave the US Army in the same state. Unlike Rommel, the US Army has a robust AP mine capability in Volcano, Modular Pack Mine System (MOPMS) and Area Denial Artillery Munition (ADAM). The finite life of these scatterable mines is a potential problem in a long battle, but one easily countered by reseeding. Additionally, the flexibility and speed of scatterable mine delivery systems means that the reseeding can be concentrated where needed most, at the critical moment. This capability is not available with conventional anti-personnel mines.

This section demonstrated that even without conventional anti-personnel mines, turn and block effect minefields can still perform their functions. This is an important conclusion because it means that the ban does not degrade mine warfare's ability to canalize and redirect an attacker. While these last two sections suggest that the ban will not degrade mine warfare's ability to influence enemy maneuver, the question of the ban's impact on force protection remains.

IX. The Ban's Effect on Protecting Friendly Forces from Assault

On a cold March night in 1952, Lieutenant Bernard E. Trainor and his platoon were preparing defensive positions on Hill 59 in Korea. They had captured the hill two nights before in one of the "test of will" operations staged for the peace negotiations in nearby Panmunjom. Trainor knew that a counterattack was inevitable, and had his platoon lay a hasty protective minefield in anticipation. That night, the Chinese tried to retake the hill. Between the crashing of the mortar shells and rattle of machine guns, Trainor could distinctly hear "...mines detonating and shrieks of agony." In Trainor's opinion, the anti-personnel mines they installed saved his platoon from being overrun that night.[73] Lieutenant Trainor's experience illustrates the land mine's role in protecting soldiers from direct enemy assault. When integrated into a unit's final defenses in this manner, land mines serve as "...[the] trump card of troops who find themselves disadvantaged on the battlefield."[74] This section examines whether mine warfare can still fulfill this critical counter mobility role in light of the ban on conventional anti-personnel mines.

Mine warfare's primary tool to protect friendly personnel and installations from enemy assault is the protective minefield. Protective minefields provide protection from assault in one of two ways: they delay an attacker long enough for the defender to break contact, or they break up an attacker's assault, buying time for the defender to complete the attacker's destruction. Doctrine calls for a combination of AT and AP mines in the construction of protective minefields. The exact mix of the two mine types depends on the tactical situation. In the case of an armored force using a protective minefield to secure against close in infantry action, the mixture should include a higher percentage of AP mines. An infantry force seeking protection from armored assault would naturally use a greater percentage of AP mines. The broad category of protective minefields is divided into two subcategories, hasty and deliberate protective minefields. These two subtypes serve slightly different roles in mine warfare.[75]

Units use hasty protective minefields to supplement and strengthen their final defensive perimeters. Units typically construct these hasty minefields from the mines in their basic load, and position them just beyond hand grenade range, integrated with their final protective fires.[76] One important characteristic of these minefields is that they are typically emplaced with ease of recover in mind. Under normal circumstances, a unit will recover its unexploded mines when it leaves a position, so it can prepare a new minefield at its next defensive location. This requirement for easy recovery also explains why non-metallic mines and AHDs are not used in hasty protective minefields.[77] LT Trainor's story demonstrates the potential of a well-prepared hasty protective minefield, and underscores the potential threat the ban poses to countermobility operations.

The absence of anti-personnel mines is clearly detrimental to a hasty protective minefield's effectiveness. The 7th Armored Division's experience during the first night of Operation Supercharge (at Alamein) demonstrates this fact. By the night of 24 October, the 7th Armored was fully through the first mine belt, and preparing to break through the second. During their preparations, they discovered a hasty protective minefield laid behind the second belt. The division's infantry attacked through the minefield, taking some casualties from direct fire and the few S-mines incorporated into the minefield, and overran the German defenders on the far side.[78] This is a very different result than that experieced by LT Trainor, and reflects the importance of anti-personnel mines to hasty protective minefields. Fortunately, even with the ban, the US Army does not share the German dilemma.

The scatterable anti-personnel mines still available to the Army more than make up for the conventional mines lost to the ban. The temporary nature of these mines is not a problem because hasty minefields are intended to be temporary measures. Furthermore, MOPMS dispensers, the best choice for hasty protective minefield emplacement, are compact and quick-acting. Two soldiers can easily carry a MOPMS dispenser into position, and then move to a safe, covered location to activate it. Once in position and protected from enemy fire, the soldiers can remotely activate the dispenser which then flings its twenty-one mines into position "in much the same way that a trap/skeet dispenser flings clay pigeons." Thus, scatterable mines can simplify a unit's logistical problems and make the time a unit would formerly have to spend on mine emplacement and recovery available for other task. While the ban poses no threat to hasty protective minefields, the same can not be said for deliberate protective minefields.

Deliberate protective minefields are used to protect "static assets" such as logistical sites, communications nodes, airfields, etc. They are identical to their hasty counterparts in every respect but one, they are intended to provide continuous protection over long periods of time. This requirement for long-term protection sets up the first problem that the ban generates.

Without conventional anti-personnel mines, one can not create a reliable, deliberate, protective minefield. The President implicitly admitted this problem by excluding Korea from the ban, due to the need for long-term protection along the de-militarized zone (DMZ).[79] There are work-arounds available to mitigate this problem. Units desiring deliberate protective minefields could use booby traps and anti-handling devices (AHD) in conjunction with AT mines to provide protection, but the Alamein example cited thus far suggests that these are less effective substitutes. The fact is that until the Army finds adequate substitute technology, the ban will hinder mine warfare's ability to satisfy this portion of its countermobility purposes.

This section yields mixed conclusions about how the ban effects mine warfare's ability to protect friendly forces from enemy assault. Mine warfare will still be able to provide protection for units in defensive positions through hasty protective minefields. However, its ability to provide long-term protection to fixed facilities through deliberate protective minefields becomes problematic. Thus, this section shows the first example of the ban hindering mine warfare's ability to fulfill its counter mobility functions. This first loss of capability due to the ban heightens concerns over other potential effects. These concerns are addressed in the next section regarding the final function of mine warfare: the destruction of enemy personnel and equipment.

X. The Ban's Effect on Destruction of Enemy Personnel and Equipment

The destruction of enemy personnel and equipment is the most fundamental purpose of mine warfare in counter mobility operations. It is this destructive potential (or the enemy's fear of it) that allows mine warfare to accomplish all the other counter mobility tasks discussed thus far. This section explores the effect the ban of conventional anti-personnel mines will have on mine warfare's ability to serve this critical function.

Land mines enable mine warfare to accomplish its destruction tasks through direct and indirect action. Direct action refers to the innate destructive effects of a detonated land mine. Land mines destroy enemy forces directly with blast and fragmentation effects. Indirect action refers to destruction caused by direct and indirect fire systems due to the presence of mines or minefields. Any time a minefield increases an enemy's exposure to friendly fire, one should attribute part of the credit for the ensuing enemy casualties to the mines. While it is easy to measure the impact of mines in a battle due to direct action, it is very difficult to quantify the mine's indirect action impact. One can not determine whether the presence of mines led to a particular direct fire kill any more than one can say that only the absence of mines allowed a particular tank or soldier to survive. One way around this problem is to assume that enemy destruction due to indirect action varies in proportion to the disruption of his maneuver. Then one can infer a minefield's indirect action from the observed disruption of the enemy's maneuver. This scheme provides a useful tool for examining the destructive impact of Alamein's minefields.

Even with a paucity of anti-personnel mines, mine warfare proved very destructive at Alamein. The eleven day battle cost the British attackers 13,560 casualties (killed,

wounded or missing) and 500 tanks.[80] While these raw numbers attest to the overall destructive potential of mine warfare (through the combined effects of direct and indirect action), they do not tell the whole story. One can draw much more meaningful conclusions about the destructive impact of mines at Alamein if one converts the raw figures into percentages of the respective totals.

It has been noted, on several occasions, that while the maneuver of British armored units was severely restricted by Alamein's minefields, the paucity of anti-personnel mines allowed British (Commonwealth) infantry to move with relative impunity. This fact, when viewed in terms of the proxy scheme presented above, suggests that the minefields were much more destructive to armor that to infantry. The casualty numbers, support this conclusion. The British lost 500 of 1029 or 49 percent of their available armor in the battle. In contrast, they lost only 13,560 of 195,000 or 7 percent of their available infantry.[81] These results do not suggest that the minefields were completely without effect against infantry. The infantry suffered many casualties due to AT mines with AHDs, booby trapped aerial bombs, and scattered S-mines. The British even learned (unhappily) that while a man could safely step on an AT mine while walking, he could detonate if he hit it while running in full gear.[82] What the numbers do suggest is that if one wants to destroy personnel efficiently, one must employ anti-personnel mines.

The good news is that the ban will not effect mine warfare's ability to serve its destruction purpose. The above analysis shows that one must have anti-personnel mines to destroy personnel, but the ban leaves the scatterable anti-personnel mines in the US Army inventory. Furthermore, the ban also leaves in place the AHDs, boobytraps, hand grenades, and explosives that modern defenders can employ in the same way that

Alamein's German defenders did. Unless a much more comprehensive ban is imposed, one that eliminates <u>all</u> autonomous explosive devices, their is little danger of mine warfare failing to serve its destruction of personnel and equipment role in countermoblitiy operations.

XI. Conclusion

Jerry Cheevers wore a mask to protect his face, not his goal. He could have blocked shots quite well without the mask--goalies had played without masks for years. The mask did, however, serve two important functions. First, it protected him from injury. Second, it provided him with an additional means of executing his mission since his protected face became a viable blocking tool. These two functions, protection and enhanced defensive capabilities, are exactly the same that land mines provide for the US Army. The consequences of playing without a mask, which Cheevers' drawn-on stitches illustrated so well, are a hint at the potential consequences the Army faces if it is forced to conduct countermobility operations without land mines. It was concern over these consequences that lead to the outcry surrounding the anti-personnel mine ban.

Fortunately, the outcry was unfounded. The ban on anti-personnel mines, in its current form, poses no significant threat to the Army's ability to perform countermobility operations. This is because the ban only prohibits the Army's use of conventional anti-personnel mines. The mines that remain in the Army's inventory (scatterable anti-personnel mines and all types of anti-tank mines) allow mine warfare to most of its tasks under countermobility operations.

Countermobility doctrine assigns mine warfare four major tasks: the disruption of enemy formations and control, the canalization of enemy forces, the protection of friendly forces from enemy assault, and the attrition of enemy personnel and equipment. The first two tasks are not effected by the ban at all since US doctrine stipulates (and historical example suggests) that anti-personnel mines are not required for their accomplishment. The ban will also not degrade mine warfare's ability to attrit enemy personnel and equipment. While this function does require the use of anti-personnel mines, the scatterable types that the ban leaves in the inventory are sufficient. For this same reason, mine warfare's ability to provide temporary protection against enemy assault is also secure. The only potential problem the ban poses concerns the task of providing long-term protection from enemy assault.

Mine warfare provides long-term protection through the deliberate protective minefield, and these minefields need anti-personnel mines to be effective. Unfortunately, the scatterable anti-personnel mines that the ban leaves in the inventory all have finite lives, which makes them unsuitable for long-term emplacement. The ban sidesteps this problem, for the moment, by providing exceptions to the "no conventional AP mine use" rule in certain critical long-term situation (i.e., along the DMZ in Korea), but the problem remains. There is no doubt that the US will develop a technology based solution to this problem. What does remain uncertain, however, is the world's reaction to the solution.

While the ban poses no real threat to US operations today, the future remains in doubt. The whole idea behind the US ban on AP mines was to give the US the moral legitimacy to lead the rest of the world to a land mine free future. The proponents of the mine ban movement feet that the current US ban misses the mark.[83] These groups feel

that the current ban is an empty (and hypocritical) gesture since it eliminates only conventional anti-personnel mines. They feel that if the US keeps its scatterable systems, countries without access to such technology will continue to use conventional AP mines rather than leave themselves disadvantaged.[84] Thus, the residual mine problem will grow, and with it the pressure for a comprehensive US anti-personnel mine ban. If a future president enacts such a ban, the stitches on the mask may become real.

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